International Journal of Mathematics and
Computer Applications Research (IJMCAR)
ISSN(P): 2249-6955; ISSN(E): 2249-8060
Vol. 4, Issue 4, Aug 2014, 91-96

SOME RESULT IN FUZZY CONTROLLERS

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ABSTRACT

Much of the recent growth of interest in the field of Fuzzy sets can be attributed to the success of one particular application: Fuzzy controllers. Traditional control mechanism for complex system requires advanced engineering mathematics including the solution of difficult differential and integral equations. Fuzzy controllers are simple to build and operate. They are based on the principal of linguistic system and approximate reasoning. Fuzzy controllers have proven to be so effective that they are in the great majority of consumer electronics devices.

Fuzzy controllers are the part of everyday life. There are thousands of products in the market with fuzzy controllers. These includes autofocus cameras, motion control camcorders, washing machines that sense moisture, elevators that stop smoothly and automobile transmission and breaking system, and many more.

KEYWORDS: Fuzzy Number, Fuzzification, Granulation, Membership

INTRODUCTION

In day to day life we often face a very familiar situation, dealing with certainty. It was held that uncertainty is non-productive and unwanted to science and hence be avoided by all possible means. With this pre assumption efforts are made to develop scientific theories which lead to certainty. Bertram Russell came right out and said “symbolic logic has nothing to do with our basic existence” To measure efficiency, good home, risk in share market, depth of the phrase so sweet or a bit redder. These are all questions are subjective and situational based. Here well defined don’t precisely define it. Some time traditional methods may be complicated the situation. Many question remain unanswered like How to start with insufficient data and what when it deals with imprecise situations. When for the first time we visit a place with the data second lane then left near the temple. We rely on logics. Logic is unnatural, humans rationalize, not reason.

The scientific uncertainty, once thought of has long before attained a status of scientific concept called FUZZY. It is uniquely applicable in language based systems (linguistic systems).These fields have gained attention because of the failure of the traditional methods to tackle the problems posed by large complex systems.

Fuzzy controllers are simple to build and operate. They are based on the principles of linguistic system and approximate reasoning. Simple arithmetic operations mean that fuzzy controllers are very fast in application. They are understandable as they translate the actions of human controller into simple deterministic rules. They can adopt the heuristic rules we use daily to control machines. Controllers are producing result of simplified and user friendly. They translate the action of human controller into rule pad. It checks all the options weigh each and adapt to changing condition.

EXPERIMENT/METHOD

Consider the problem of two same dimension vehicles crossing each other. What is the approximate collision location?

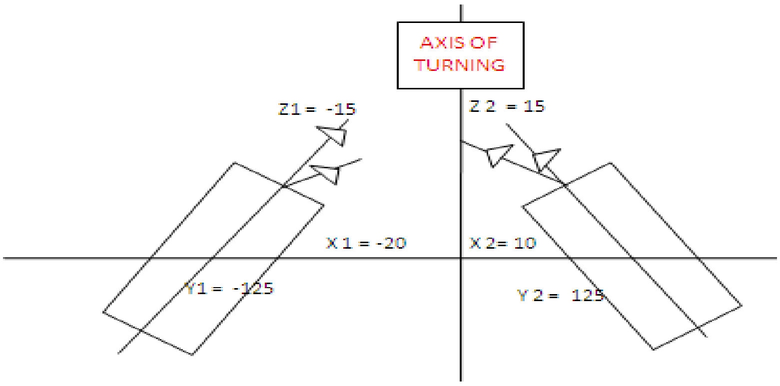


Figure 1: After Fuzzy Controller Alter the Steering Angle

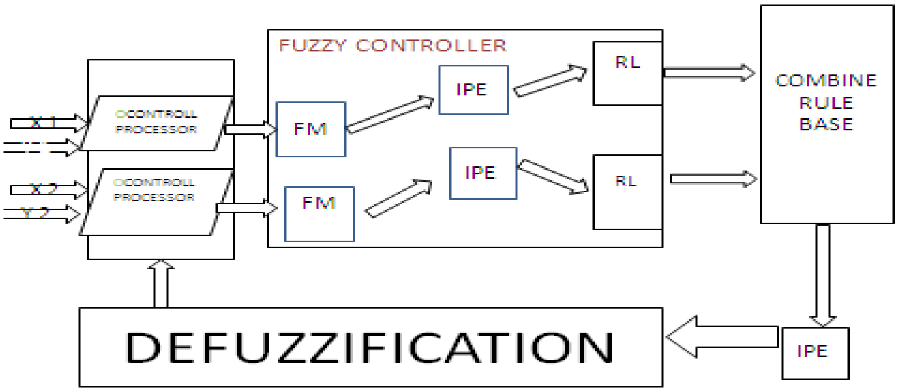
Human rules do not specify the numeric ranges. These rules are learned by way of example and feedback. Rules are based on their own reflexes and driving style. If x represent offset distance from the axis of turning and y is the measure of (major) angle of vehicle axis to offset. Let (x1 y1), (x 2, y2) be two inputs to v1 and v2. The addition of speed parameter as third input parameter the crisp rule based approach becomes more infeasible. Consider the two vehicles v1& v2 sped equally. Let z1 and z2 denotes steer angle for v 1 and v 2. z 1and z2 be two steer angle output from the fuzzy controller.

Vehicle v 1 is initially positioned as the offset distance from the axis of turning is -20.The angle made with the offset by the axis of v 1 is y = -125.Where as steering angle is z 1 is – 15. The v1 seeks to cross the road and proceed to right side. Vehicle v 2 is at the offset distance of 10 with the axis of turning. The angle made with the offset and axis of v 2 is 125. Whereas z2 is the steering angle and is 15.The angle is measure as the deviation from straight up. The ranges of x, y, z is given in the table 1.

Table 1

	V1	V 2	RANGE
Offset distance (x)	X 1 = - 20	X 2 = 10	[-40 40]
Angle(object axis) (y)	Y1 = -125	Y2 = 125	[-155 95] [-95 155]
Steering angle (z)	Z1 = -15	Z 2 = 15	[-30 30]

The working is according to block diagram1. When this inputs are fetch to the control processor.



Block Diagram 1

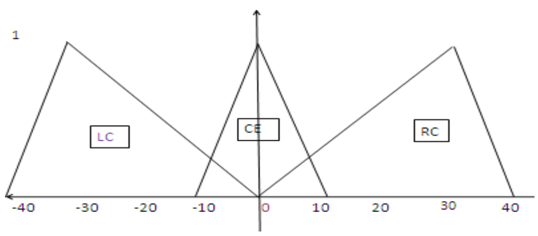
It is further fuzzified in fuzzy modular with the aid of granulation. These measurements are converted into appropriate fuzzy sets to express measurement uncertainties ranges of different heuristic variables. Granulation, defining overlapping fuzzy subsets over the domain of the variable is called granulation. Offset is partition in three, Angle and steer angle is partition in five. The angle measured in the counter clockwise is positive. Given in table No 2 The English name and fuzzy numbers assigned to their portions of offset (x), angle (y), steering angle (z) is given below.

Table: 2

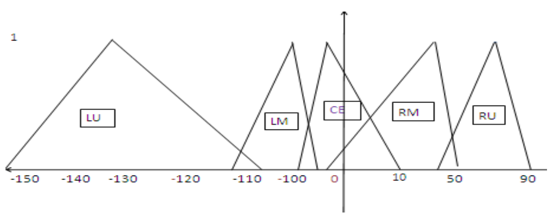
X 1	Y 1	Z 1
LC [-40 -40 -30 0] CE [-10 0 10] RC [0 30 40 40]	LU [-155 -130 -105] LM [-110 -80 -50] CE [-80 -35 10] RM [-10 20 50] RU [45 70 95]	NM [-30 -20 -10] NS [-20 -10 0] ZE [-10 0 10] PS [0 10 20] PM [10 20 30]
X 2	**Y 2**	**Z 2**
LC [40 40 30 0] CE [10 0 -10] RC [0 -30 -40 -40]	LU [- 95 - 70 - 45] LM [- 50 -20 10] CE [-10 35 80] RM [50 80 110] RU [105 130 155]	NM [-30 -20 -10] NS [-20 -10 0] ZE [-10 0 10] PS [0 10 20] PM [10 20 30]

LC – left centre, CE- centre, RC – right centre, RM – right middle, LU – left up, LM- left middle, RU – right up PM - positive medium, NM –negative big, NS – negative small, ZE – zero position, PS – positive small

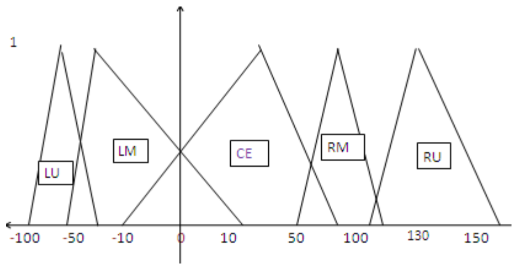
The corresponding graphs of the two sets of x, y, z for the two vehicle v1 and v 2 of given according to table 2, these show comparative positions of the variables. The fuzzy controller designed will need to have decision for any possible pairings of x, y. This above data is next fetched to interference engine to evaluate the control rules stored in fuzzy rule base. As three and five partition implies we have fifteen rules in the rule base for each vehicle. Defining steering angles z1 & z2 in Table 3



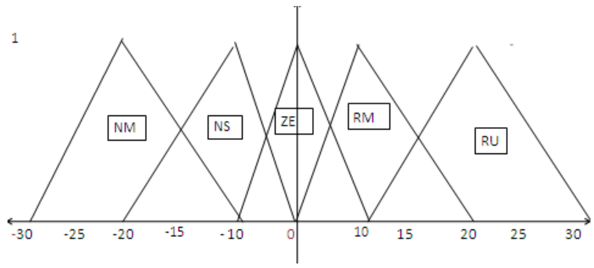
(1) Graph of x 1 and x 2



(2) Graph y 1



(3) Graph y 2



(4) Graph of z 1 and z 2

The pictorial representation of fuzzification as mentioned in table 2 is shown above for x 1 and x 2 (offset distance), y1 and y2 (angle) and z1and z2 (Steering angle) with their linguistic variables.

Table 3

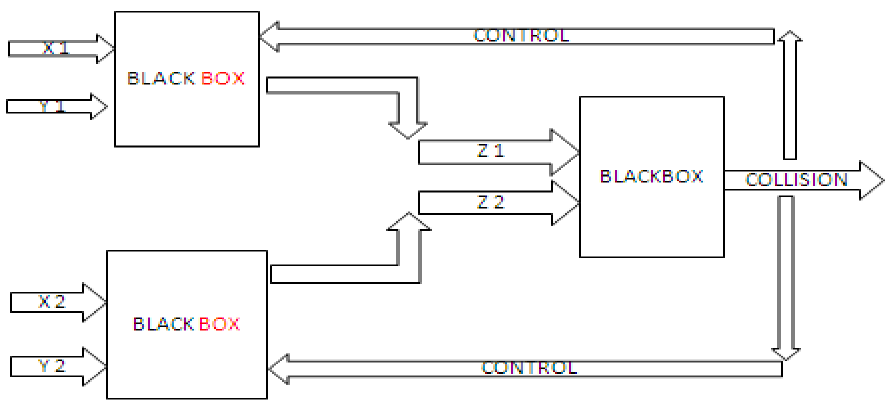
X1* Y1= Z1 X2*Y2= Z2	LU	LU	CE	RM	RU
LC	NM	NS	NS	PS	PS
CE	NS	NS	ZE	PS	PS
RC	NS	PS	PS	PM	PM

Since we have the input from figure 1 of (x 1 y 1) and (x 2 y 2).We can find out the actual membership grades of different sets granulated by the following relation. Example - μ_1 (-30) = 0, μ_1(-15) = 5/10 = 0.5, μ_2 (-20) = 1and so on.

$$\mu_1(z1) \text{ or } \mu_2(z2) = \begin{cases} 0 & z1, z2 = a \\ \dfrac{z-a}{b-a} & a < z1, z2 \leq b \\ \dfrac{c-z}{c-b} & b < z1, z2 < c \\ 0 & z1, z2 = c \end{cases} \tag{1}$$

We are in the system of two simultaneous events here collect and processed the outputs (z 1 & z 2) obtained in first part. It is too early to check for the collision. As the compatibility of v 1 and v 2 should suffix each other for collision or no collision condition

DECIDING COLLISION LOCATION



Block Diagram 2

The situation describe in the figure 1 is now in the next stage for the final decision of collision. The working is according to block diagram2.When this inputs are fetch to black box. Here the two vehicles are to be checked with respect to each other. Let us introduce five linguistic variables for the second output that is collision. Where RE- right extreme, stands for both v 1 and v2 are to the right of the axis of turning. Defining others on the same ground with their corresponding fuzzy number assigned. RE –right extreme, [-30 -25 -20], RM –right medium, [-15 -13 -11], CHC –centre [-13 0 13] LM – left medium, [11 13 15], LE –left extreme [20 25 30]. If these outputs (z 1, z 2) are processed to form combine rule base and then to interpreter. As shown in block diagram 1. Number of rules are (five into five) twenty five. The fuzzy relation for z 1, z 2 is modeled as fuzzy set whose membership function at (z 1, z 2) is given below. The combined rule base is updated on the basis of the membership grades. As RE= RNC (right no collision), RM = RPC (right partial collision), CHC= (centre head on collision), LM = LPC (left partial collision), LE= LNC (left no collision). From the figure 1 it is clear that there can be calculations for the needed points. Using membership grading already given in equation no. 1.we computed the following nodes and their combine corresponding membership according to equation 2is given in Table no 4. The Combined Rule Base is stated in Table 5.

$$\mu(z\,1 \wedge z\,2) = \begin{cases} \dfrac{\mu(z\,1) + \mu(z\,2)}{2} & for\ z1, z\,2\ with\ same\ sign \\ 1 - \dfrac{\mu(z\,1) + \mu(z\,2)}{2} & for\ z1, z2\ with\ opp.\,sign \end{cases} \tag{2}$$

Table 4

Z1*Z 2	NM	NS	ZE	PM	PS
NM	RNC	RNC	RPC	RPC	CHC
NS	RNC	RPC	RPC	LPC	LPC
ZE	RPC	RPC	CHC	LPC	LPC
PM	RPC	LPC	LPC	LPC	LNC
PS	CHC	LPC	LPC	LNC	LNC

Table 5

Z 1,Z 2	-30	-15	0	15	30
-30	0	0.25	0.5	0.8	1
-15	0.25	0.5	0.8	0.5	0.8
0	0.5	0.75	1	0.8	0.5
15	0.75	0.5	0.8	0.5	0.3
30	1	0.75	0.5	0.3	0

If both vehicles goes for the following compactable order pairs then head on collision is for sure that is their combine membership is one. (-30,30) (30,-30) (0,0) (-10,-10) (-10,0) (0,10). The slight deviation (to left of the turning axis) from initial position including initial position and left or right extreme is the collision sensitive location.

The last step in the fuzzy controller is to produce a single real number to use as the control value the number of degrees that the steering angles should move or altered from the present position by both the vehicle v 1 and v 2. The largest resultant membership value in fuzzy set (CHC) as a control value. As in this case highest membership is for the interval of [-10 0 10] which is the subset of CHC. Then by COG (centre of gravity) the control value is 0 [for unaltered position]. For [-30 30] or [30 -30] that is. [Both goes left or right extreme], the control value is the rule stated Madami 0.Once the locations are marked, work can be done to avoid it.

RESULTS/CONCLUSIONS

- For simultaneous events FLC can act as boon to get handy results
- The order pairs of the sort (z 1, - z 2) or (-z 1, z 2) where z1 and z 2 are equal or deviated by very small figures have the highest membership for collision.
- The control value determined is zero shows that both v 1 and v 2 should not go for the same direction and angle.
- For the compactable index in the system gives a feasible solution than traditional methods.
- If accompanied with sensor or a change lane signal for warning at the turning, accident could be avoided.
- Fuzzy logic is implemented not only in artificial intelligence but in anything related to decision making with the help of information processing.

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